IMPACT OF WASTE DISCHARGES FROM CITY OF EDMONTON WATER TREATMENT PLANTS ON BIOLOGICAL WATER QUALITY OF THE N. SASKATCHEWAN RIVER

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March 1982

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Clarifier discharge, primarily an alum sludge, from the E.L. Smith and Rossdale water treatment plants in the City of Edmonton had been identifed as having a possibly detrimental impact on the water quality of the North Saskatchewan River. It was hypothesized that the impacts would be from modification of the habitat by sludge deposition and substrate impairment furthermore the possibility of a toxic component from the alum sludge was considered.

Municipal Engineering Branch funded an investigation of the magnitude of these impacts on the river through study of the benthic invertebrate community. Interpretation of their data is presented here.

Benthic invertebrate samples were taken up and downstream of the discharge points at the two treatment plants (Table 1). At each sampling site five replicate sample units were taken with a Neil cylinder sampler (Neil 1937, Alberta Environment 1975). Samples were identified as far as possible usually to the generic level. Samples were taken on two occassions, the fall of 1980 and spring 1981.

Two approaches have been taken in analyzing and interpreting these data. First a principle components analysis was preformed on the data for each of the two sampling occassions (Clustan). This technique utilises the entire data set and identifies patterns and changes in the community structure. Second the major groups of animals, based upon their sensitivity to change were examined for identification of downstream responses.

Principle Components Analysis

Fall 1980.

Using P.C.A. (principle components analysis) the first two components are shown in figure 1 and explain almost 50% of the variance in the data set. On both components the variance is explained by animals that are considered as being representative of "clean and dirty" water. Namely, mayflies, stoneflies chironomids and tubificid worms. On PCI (first component) 50% of the variance is explained by four of the thirteen variables (taxa), on the second new variable

(PCII) four variables (taxa) explain 60% of the variance. The most obvious feature of this analysis is that the Rossdale sites are all oriented towards the orthocladinae and oligochaeta, these two groups accounting for most of the variance in these sites. The E.L. Smith sites are biased towards Isoperla (stonefly) and Brachycentrus (caddis fly) on PCII but show most of the variation on PCI. The Rossdale cluster does seem to show a difference between the upstream and downstream sites with some separation on PCI. The E.L. Smith sites show no real differences between upstream and downstream with the exception of the samples taken at the outfall which form a tight and distinct cluster. The upstream samples are distributed within the downstream sites on the cluster diagram.

Spring 1981.

Using PCA there again appears a distinction between the Rossdale and E.L. Smith sites and from the Rossdale plant a measurable difference between upstream and downstream locations on PCI with increased bias towards mayflies and Hemerodromia at the upstream locations. The E.L. Smith sites again show the outfall samples to form a distinct group with an absence of mayflies and stoneflies. Also on this occassion there is a difference between the upstream and downstream locations shown on PCI.

Summarizing these results; first there is good evidence for a change in the biological structure of the benthic community between the E.L. Smith plant sites and the Rossdale sites. Second there is an obvious modification in the community at the E.L. Smith outfall. Finally there is some evidence of impact downstream at 50m and 200m from discharge in both plants. There are differences between upstream and downstream at Rossdale in both spring and fall, but only in the spring from the E.L. Smith plant.

Examination of the major groups at these sites suggests a mechanism for these observed changes. The difference between the river in the region of the Rossdale compared with the E.L. Smith plant can be seen in figure 3, to be an increase in numbers of oligochaetes and chironomids, particularly in the fall, and a decrease in the numbers of mayflies and stoneflies (ephemeroptera and plecoptera) in the spring. These changes are typical of a benthic community

response to organic loadings and suggest a source of inputs between the Smith and Rossdale plants. This it is presumed are the city storm sewers, there are twelve major storm sewers together with Whitemud Creek which drain a major portion of the city discharging between these locations.

The only obvious effect observed from the treatment plant discharge is at the site located at the outfall of the Smith Plant. This is particularly noticeable in the fall when the community is almost non-existant. The effect appears to be one of habitat modification and is not as severe in the spring possibly due to recovery of substrate from spring scouring.

At this level of analysis the community modification at site 50 and 200 metres downstream of the outfalls is very slight and not felt to be cause for concern.

It is suggested that the major impacts from the sludge discharge are aesthetic rather than having a significant effect of the biological community of the river and it is felt that there is no evidence for aluminum toxicity from these data rather that the impact from the discharge is very local, at the outfall, and a result of structural changes in the substrate. More significant is the apparent effect of organic discharges to the river, probably from the storm sewers upstream of the Rossdale W.T.P. intake.

Table 1

Benthic Invertebrate Sample Sites
North Saskatchewan River (Sludge Discharge Study).

Site No.	Location
1	Upstream of Smith W.T.P. outfall
2	At Smith W.T.P. outfall
3	50 metres downstream of Smith W.T.P. outfall
4	200 metres downstream of Smith W.T.P. outfall
5	Upstream Rossdale W.T.P. outfall
6	50 metres downstream of Rossdale W.T.P. outfall
*7	200 metres downstream of Rossdale W.T.P. outfall

* not sampled fall 1980

FIGURE 1: NORTH SASKATCHEWAN RIVER
AUTUMN, 1980

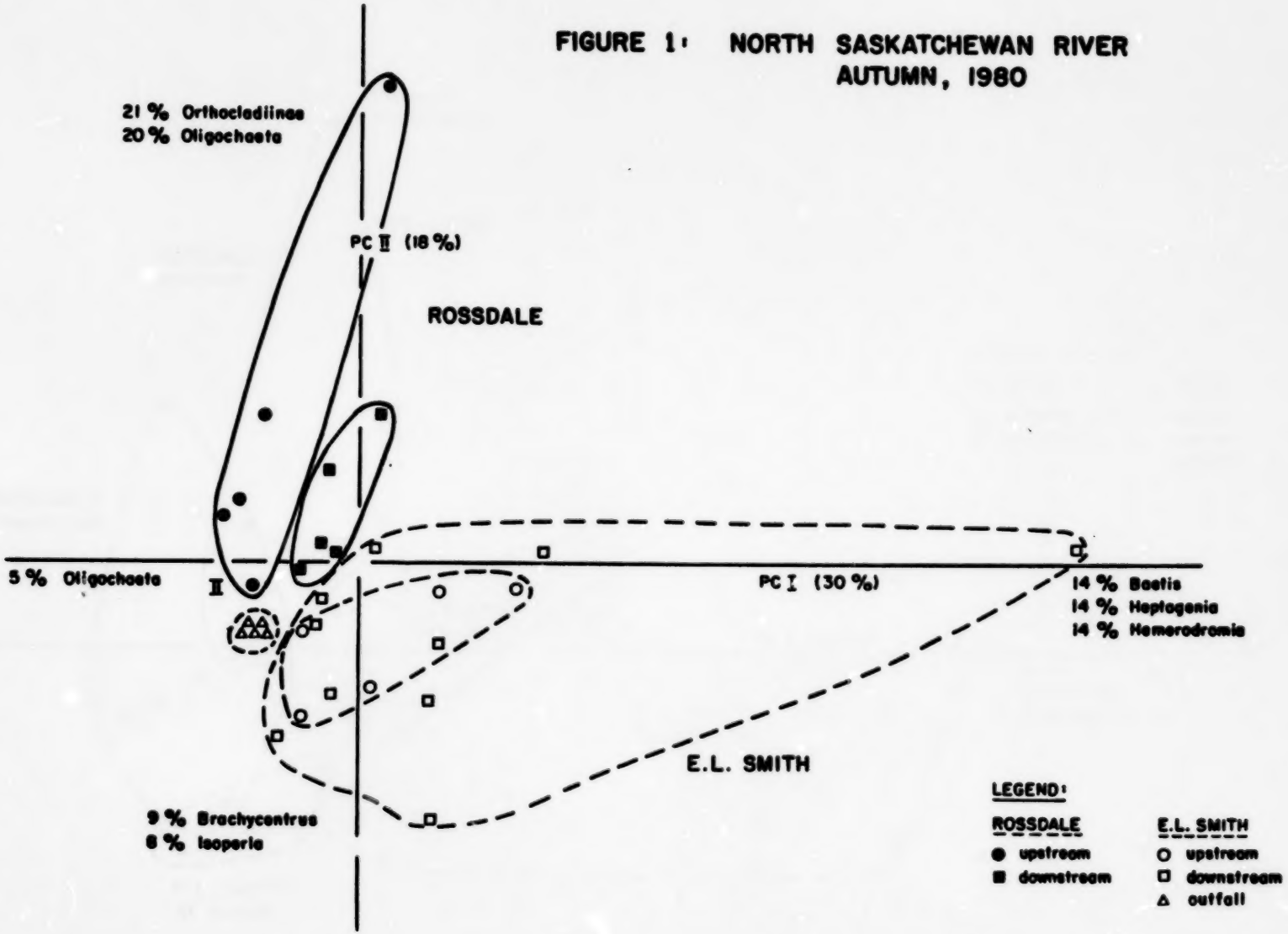

FIGURE 2: NORTH SASKATCHEWAN RIVER
SPRING, 1981

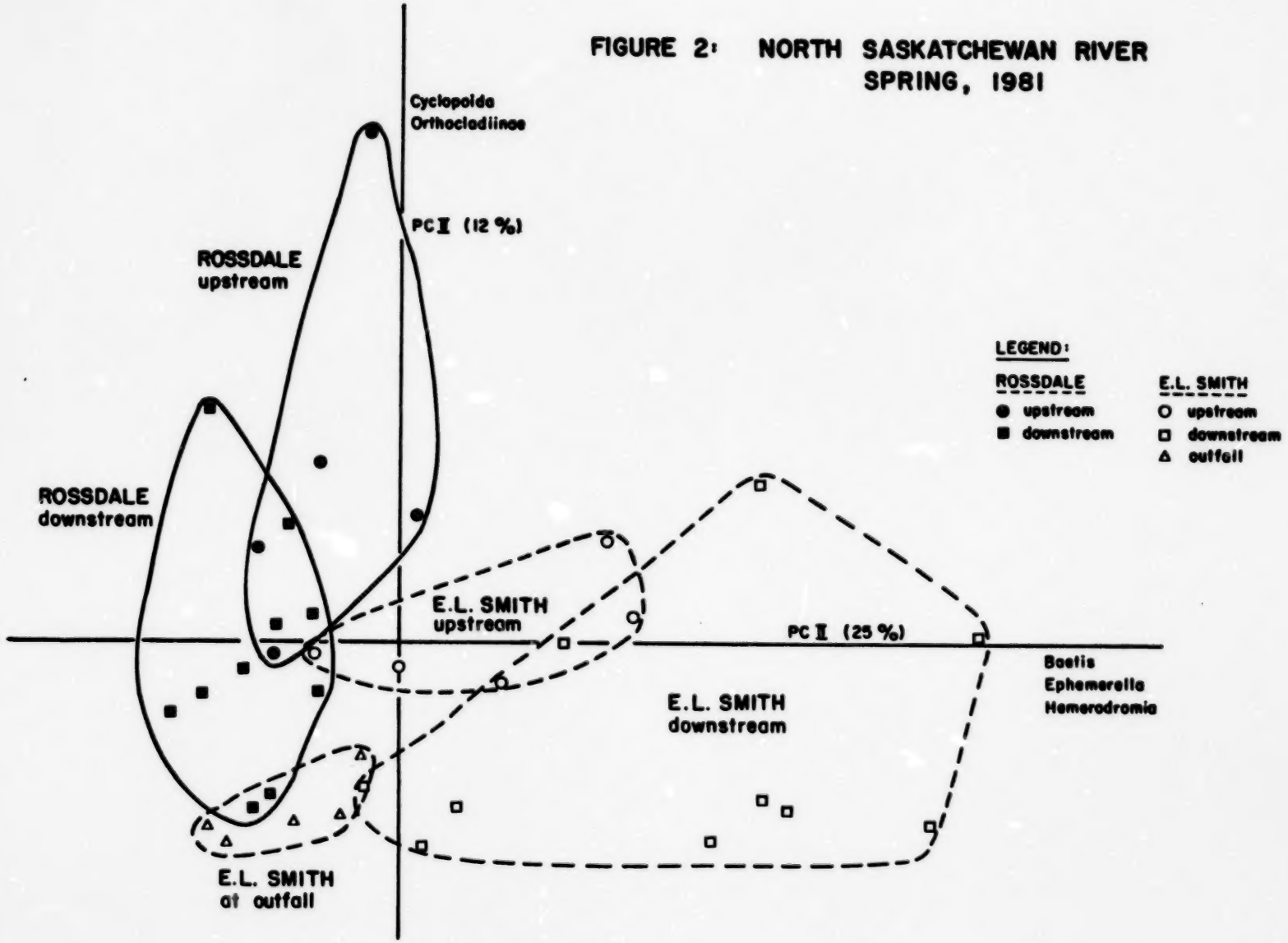

FIGURE 3

NUMBERS OF MAJOR GROUPS OF INVERTEBRATES
IN THE NORTH SASKATCHEWAN RIVER